

Integrated Erasure-based Coding for Reliable Multicast Retransmission

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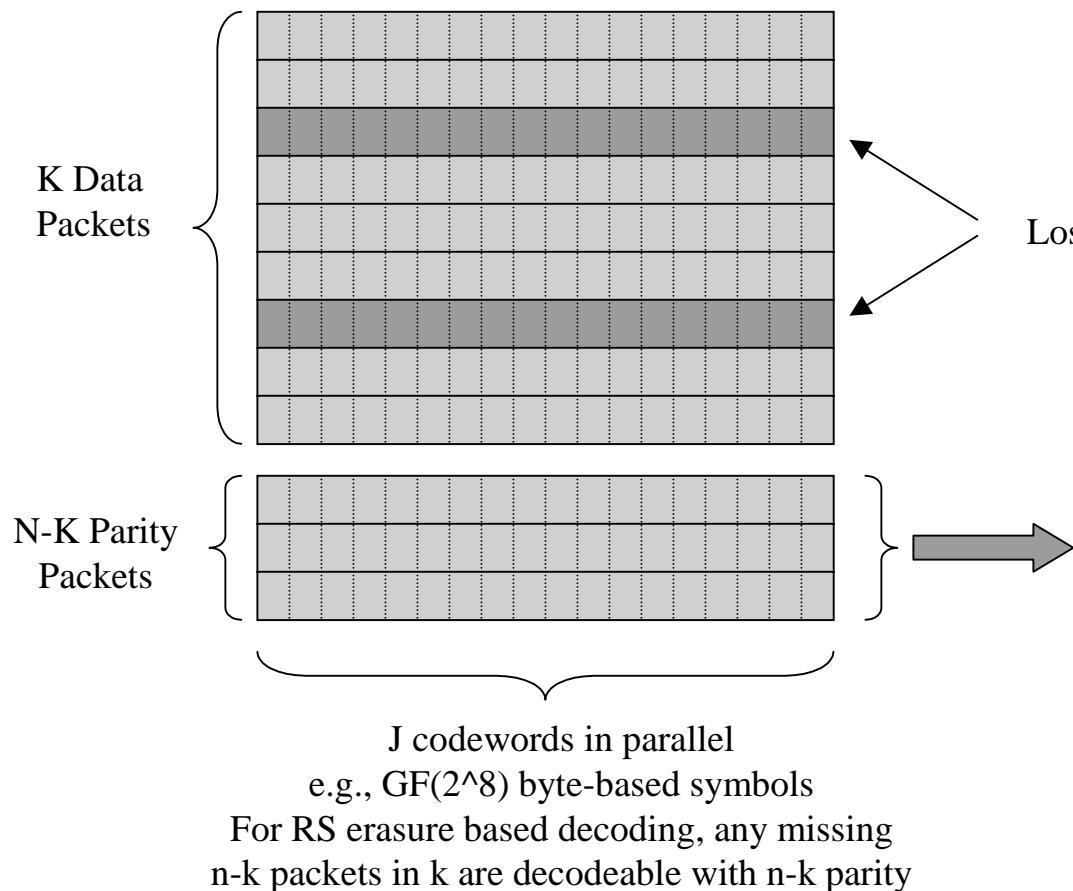
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Some Background



Erasure-based Correction Methods

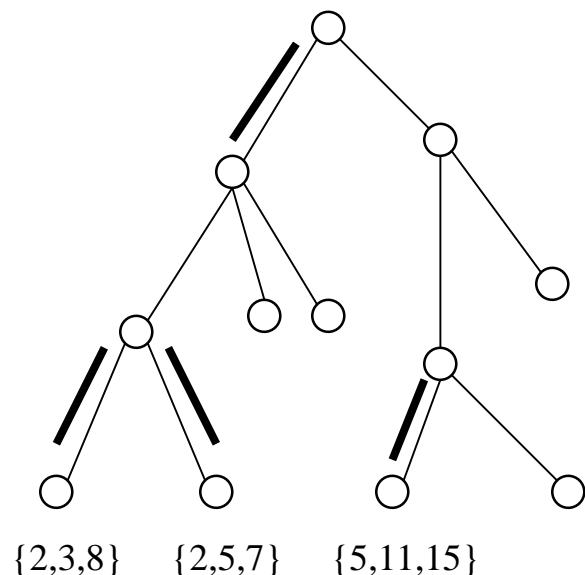
- 1) Send parity with DATA
Fixed or Variable code rate
- 2) Request Parity Retransmission
Send 0 parity on 1st block cycle
- 3) Hybrid
Send some parity with data block,
request more when conditions worsen

Integrated Retransmission

- Don't transmit any parity on 1st cycle
- Modify RM Nack Process
 - report only max lost among receiver group {block id, max lost}
 - can still do repair backoff
 - no parsing nacked sequence numbers, block bit maps, etc
- Scaled groups can show large % loss in total
 - single retransmitted parity can repair multiple lost packets
 - significant RM message reduction for uncorrelated loss cases
 - with an integrated retransmission approach you do not have preestimate the amount of parity needed

Performance Gain for Uncorrelated Loss

E.g., Transmit Block (1..20)



Total Lost Packets = 6
Max Lost Per Receiver = 3

- Single parity packet can repair multiple packets across receiver set
- We can integrate this into Nack processing to improve scaling when uncorrelated loss is anticipated
- Can use this for streaming but there is:
 - delay penalty
 - processing penalty
- Makes a lot of sense for bulk transfer to large groups in one-to-many environments

Simple Loss Model Example

1. uncorrelated packet loss
2. Homogeneous loss probability
3. N = packet block size, M = receiver group size

Expected Value of 2nd Cycle Repair Retransmissions?

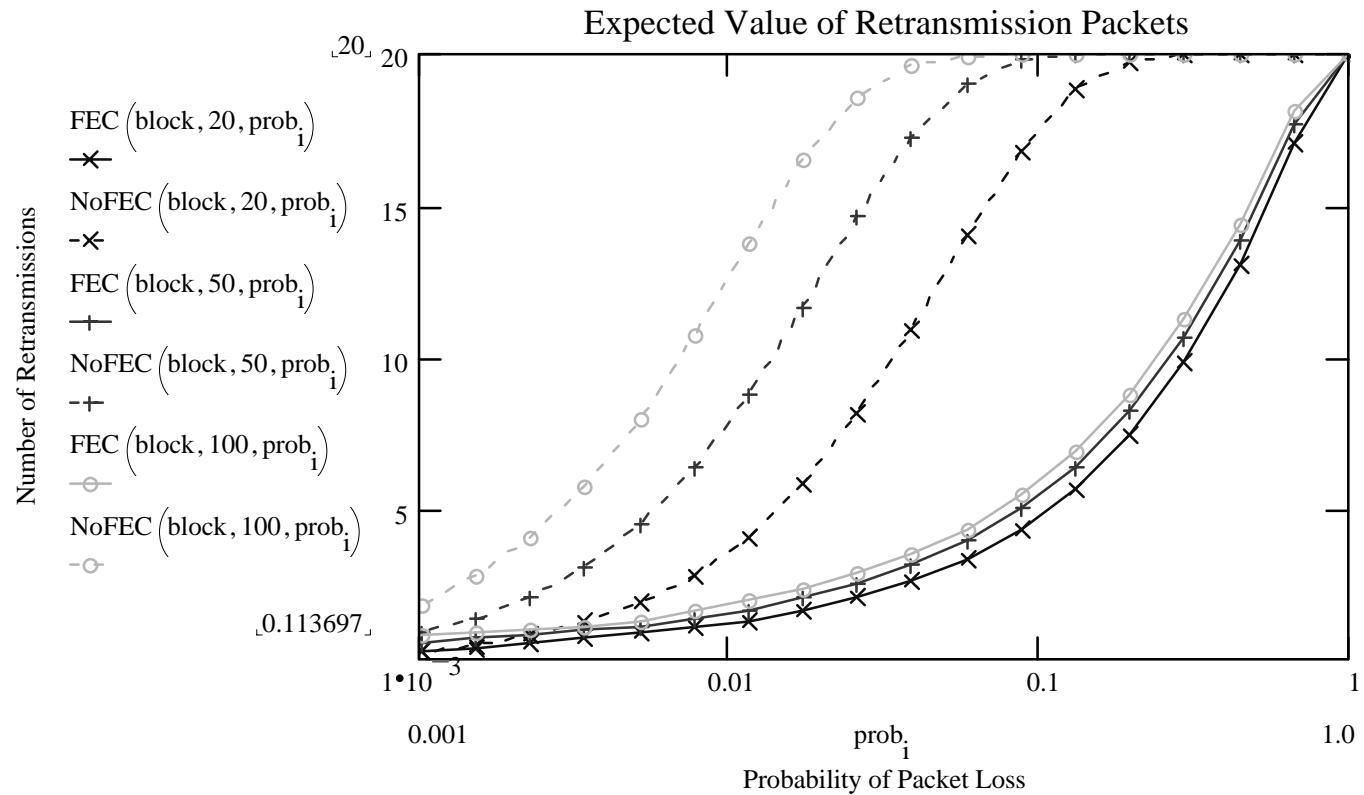
$$\text{NoFEC}(n, m, p) := n \cdot \left[1 - (1 - p)^m \right]$$

With parity erasure-based repairing
here's the pdf of the max among nodes

$$\text{pdfFEC}(n, m, p, k) := \sum_{j=1}^m \frac{m!}{(j!) \cdot (m-j)!} \cdot \text{dbinom}(k, n, p)^j \cdot \text{pbinom}(k-1, n, p)^{m-j}$$

$$\text{FEC}(n, m, p) := \sum_{i=1}^n i \cdot \text{pdfFEC}(n, m, p, i)$$

Example Message Reduction



Block=20 packets, Group Sizes of 20,50,100

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